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ARGUMENT IN SUPPORT OF ALLOWANCE

Status

In the above-referenced Office Action, claims 1-3 and 5-8 have been finally rejected as being obvious over Noguchi (JP Patent PD No. 2001-203099) in view of Akimoto (USP 6,189,481) and Kuehnle (USP 4,294,678), and claim 4 has been rejected as being obvious over Noguchi in view of Akimoto '481 and Kuehnle '678, and further in view of Matsumoto '807. Applicants respectfully disagree with the Examiner's basis for rejection and in furtherance of their position, conducted a telephonic interview with the Examiner on 9 July 2007. Applicants appreciate the discretion afforded by the Examiner in granting the interview request, and submit that the time was well spent. As a result of the interview, applicants (through the undersigned) and the Examiner arrived at a tentative agreement concerning the constitution of an allowable form to claim 1. This response constitutes applicants' attempt to formalize that understanding and advance this application to allowance. The Examiner is strongly encouraged to carefully review this submission to ensure that the parties' intentions are faithfully carried out.

CHARACTERIZATION OF THE CLAIMED INVENTION AND THE CITED PRIOR ART REFERENCES

The subject invention is directed to structure for controlling the level of plasma generated in a plasma generating apparatus by varying the degree of destructive interference in a wave guide between a propagation electromagnetic wave emanating from a microwave generator and a reflected electromagnetic wave. This control over plasma generation may achieved, for example, by modifying the size of a hole area located at a terminal end of the wave guide. Modification of the hole area results in alteration of electromagnetic wave interference within the wave guide due to reflection of the electromagnetic wave at the terminal end thereof. *See* [0044] of applicants' specification.

In plasma generating apparatus not employing the invention, the reflected electromagnetic wave at the terminal end of the wave guide can destructively interfere

with the propagation wave, thereby decreasing the amount of radiation exiting the wave guide through the various openings (antennas), and thus negatively affecting the quantity and quality of plasma generated in a chamber of the apparatus. Therefore, the subject invention provides a means for variably preventing the generation of reflected wave(s) at the terminal end of the wave guide, and thus controlling the amount of plasma generated in the reaction chamber.

Noguchi at FIG. 3 discloses a plasma processing apparatus having a wave guide (11, 12) that defines a plurality of slot antennas (13). As stated in the Abstract, "...the size of the wave guide 12 for radiation is changed locally in the vicinity of the slot antennas 13 so that the wavelength of the microwave in the wave guide 12 for radiation is changed locally to enable to control the strength distribution of the electromagnetic radiation from the s[l]ot antennas 13 toward the discharge chamber 30." Thus, the invention of Noguchi achieves local volumetric change within the wave guide by employing dynamic wave guide walls that change the microwave radiation density distribution within the wave guide: movable wall portions 16 in Figs. 4(a), 4(b), and 4(e); movable plunger 20 in the several Figures, including wave guides with non-symmetrical walls, e.g., Figs. 4(c) and 4(d). Simply stated, Noguchi varies the wave guide internal volume to vary the propagation wave characteristics.

The stated advantage of the invention disclosed in Noguchi is that the slot antennas may be optimally located along the wave guide based upon exposure criteria (relative to a target wafer, for example) without primary concern over the resulting microwave energy distribution; issues of energy distribution are addressed by configuring the interior physical geometry (volume) of the wave guide: "...for the purpose of offering plasma production equipment with which the degree of freedom of slot antenna arrangement is raised so that the initial plasma distribution at the plasma generating time by be controlled to a request." [0009].

While this reference is notable for the variety of means advanced for modifying the microwave wave characteristics within the wave guide (see Figs. 4(a) – 4(e)), it is further notable for what it does not disclose nor teach: There is no disclosure,

suggestion, motivation or teaching of energy modulation by any means other than modification to the internal geometry (volume) of the wave guide.

Akimoto discloses a dielectric line in a chamber and shutters to all microwave radiation ports of the same aperture provided on the dielectric line, with each of the shutters controlling an aperture area to control a plasma density within a reaction chamber. It is important to note that Akimoto is only concerned with microwave distribution into the reaction chamber via direct means: "The apparatus includes a mechanism which allows the areas of radiation ports formed in an upper electrode to be changed independently of each other. This allows a plasma distribution in a plasma processing chamber to be controlled in any desired manner." Abstract. The direct means involves varying the openings of all radiation ports in the wave guide to modulate the level of emitted radiation used to generate the plasma in the chamber.

The prior art deficiencies in controlling the distribution of microwaves into a reaction chamber, which lead to the invention of Akimoto, related to non-apertured radiation ports in a wave guide for a plasma processing apparatus. *See* Fig. 1B. As stated in Akimoto: "However, controlling the plasma distribution through the control over the microwave distribution in the waveguide is not a direct implementation. With this kind of method, it is difficult to control the plasma distribution in a desired manner." (emphasis added). It is therefore quite clear that the technical problem to be addressed in Akimoto was not plasma density per se, but plasma distribution within the reaction chamber. The Summary of the Invention section bears this out: "...a microwave plasma processing apparatus capable of controlling a plasma distribution in a plasma processing chamber in a desired manner." Column 1 at lines 54-56. *See also* column 3 at lines 46-58.

While Akimoto extols the virtues of his invention with respect to plasma distribution, he is silent with respect to any physics occurring **in** the wave guide. Alternatively stated, Akimoto's sole concern relates to the intensity of target exposure to generated plasma, and solutions that involve varying the opening of all radiation apertures positioned, presumably, equidistantly on the radiation line (wave guide). There no disclosure regarding the conditions within the wave guide, nor guidance

regarding the consequence to such environment when actuating operating members (64). Consequently, there is no disclosure relating to a problem caused by a reflected wave within the wave guide and its countermeasure technique.

Kuehnle is relied upon for his discloses of a sputtering apparatus in which shutters are provided at each access port between a target in a chamber and an anode; the shutter is selectively opened or shut to expose or occlude the anode the chamber.

PROPRIETARY OF THE COMBINATION ALLEGED TO SUPPORT THE SECTION 103(A) REJECTION

The Examiner's obviousness rejection hinges on the combination of Noguchi and Akimoto. However, applicants submit that the combination advanced by the Examiner is improper. As stated above, Noguchi has attempted to solve a problem similar to that identified by applicants, namely, constructive and destructive microwave interference occurring within a wave guide of a plasma generating apparatus. Noguchi dynamically modulates the cavity wave patterns by varying the physical geometry of the interior walls (volume) of the wave guide. No reference of record indicates that the methods and apparatus proposed by Noguchi are deficient or inoperative. Thus, applicants submit that a skilled practitioner would not be inclined to improve upon or change the invention of Noguchi when addressing the technical problems.

Even if the skilled practitioner was inclined to improve or change the invention of Noguchi, the question then must be asked "how" such an invention would be changed without engaging in impermissible hindsight. The cited prior art only illustrates Noguchi's technology as a viable means. Akimoto wholly fails to provide any guidance that his methods and apparatus would have any appreciable effect on the microwave energy within the wave guide. In fact, Akimoto teaches away from any effort to improve operations of the apparatus through "indirect" means: "Therefore, it is extremely difficult to control the plasma distribution only through the control over the microwave distribution in the waveguide." Column 1 at lines 47-49. That is because Akimoto is only concerned with microwave distribution within the chamber, and therefore relies on direct emission control means (shutters). In contrast, applicants (and Noguchi) are not concerned with the physical location of the radiation ports (antennas), but with

modulation of the microwaves within the wave guide. Thus, the skilled practitioner seeking to modulate the microwaves within a wave guide of a plasma processing apparatus would not seek information regarding methods and apparatus that have no demonstrated effect on such modulation (Akimoto lacks such teaching, motivation, suggestion or the like).

Absent a showing that the skilled practitioner would know that the inclusion of a radiation port/antenna having a variable shutter within the wall(s) of a microwave guide modulates the wave characteristics therein, and that such inclusion within the claimed apparatus would yield an operative apparatus, it cannot be maintained that the combination advanced by the Examiner is proper. Applicants stress that the existence in the prior art of the elements of applicants' invention is insufficient where the elements are directed to disparate technical objectives and there is no disclosure or teaching that such a combination would yield the advantages of the claimed invention.

While the Examiner agreed with applicants' proposition above[1], applicant offered to refine claim 1 to better present this fundamental difference. Therefore, applicants have amended claim 1 so that not all holes in the wave guide have hole area adjusting means. In all cases, Akimoto discloses and teaches the incorporation of shutters for each and every hole (port/antenna/etc.). This arrangement is apparently necessary in order to provide the degree of control sought by Akimoto. Applicants' Fig. 1a discloses such means in one hole, while Figs. 2, 3a and 4b, for example, disclose such means occupying a plurality of holes, but not all holes, for each wave guide. Thus this limitation is both supported by the specification and further defines over the prior art of record.

In addition to the foregoing, applicant offered to change the functional language following this revised claim limitation to better emphasize the initial effect of such hole area adjusting means, namely, modulating the waveform of the propagating wave (which necessarily modulates the density of plasma generated in the chamber during operation thereof).

[1] Applicants' limitation of the hole area adjusting means being "in" at least one of the plurality of holes clearly removes Akimoto from direct application (Akimoto's shutters are disposed within the reaction chamber).

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Lastly, applicant has deleted the claim limitation relating to the internal volume of the wave guide, as that limitation is no longer necessary to overcome any relevant prior art, and has otherwise refined the claims for consistency purposes.

Applicant respectfully requests that the Examiner withdraw the rejection of claims 1-8 in view of applicant's arguments. This response is being submitted within the shortened statutory period identified in the referenced Office Action, therefore no extension fee is believed due. Additional, applicant has not exceeded the number and type of claims previously paid for, and therefore submits that no excess claim fees are due. However, should any additional fees be required, please charge them to Deposit Account No. 07-1897. Given the lack of other basis for rejecting the application, applicant submits that the application is presently in condition for allowance. If any matters remain unresolved after consideration of this response, the Examiner is strongly encouraged to contact the undersigned by telephone as soon as possible.

Respectfully submitted this 11th day of July 2007.

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